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UPON THE VIRULENCE OF
THE BACILLUS OF BOVINE AND
HUMAN TUBERCULOSIS
FOR MONKEYS

BY

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UPON THE VIRULENCE OF THE BACILLUS OF BOVINE AND HUMAN TUBERCU- LOSIS FOR MONKEYS.

THE experiments forming the subject of this note were undertaken with the view of ascertaining in how far the human and bovine strains of the tubercle bacillus agree or differ as regards their infective properties for the monkey. The methods adopted were mainly feeding experiments, as the particular object of the investigation was to determine to what extent the digestive tract is capable of acting as a channel of systemic invasion for tubercle organisms derived either from cattle or from man. There is naturally an entire absence of direct experimental evidence with regard to the possible transmission of the bacillus of bovine tuberculosis to the human subject by means of articles of food. It was therefore considered that the experiments might furnish at the same time indirect evidence upon this important and debateable point. It is in young children that, generally speaking, such bacterial infective processes are liable to occur on account of the anatomical structure of the intestinal wall and its lymphatic system. A food tuberculosis is most likely to appear in children by the consumption of unsterilised dairy milk. One may, indeed, go so far as to say that as regards tuberculosis and its transmissibility through food channels the danger that may exist is peculiar to children at the period in which a milk diet predominates.

The monkey is the species of animal in which results comparable in character to those possibly occurring in man can be obtained. The animals that were employed were, with one exception, rhesus monkeys. The experiments were arranged to favour an infection and, at the same time, to reproduce, as far as was possible, the natural conditions as they occur in man. In the first instance the experiments were made upon young monkeys of an average age of from

12 to 18 months and in the second instance the infective material was almost entirely administered per os. It should also be mentioned that in the feeding experiments neither artificial cultures of the specific organisms nor organisms which had been subjected to a passage through other intermediate and susceptible animals were used. The natural material, proved to contain tubercle bacilli, was employed in all the feeding experiments—viz., the tuberculous tissues of cattle and the tuberculous sputum of man. The experiments in this respect differ from those carried out by certain other observers. It was considered that the test would be of a more conclusive character if the tubercle bacilli as they exist in a natural soil were employed and that a possible source of fallacy through cultural and other modifying factors would be eliminated. Precautions were at the same time taken to insure that the animals were free from tuberculosis and control monkeys of the same age and source were kept under observation in the course of the experiments. 18 monkeys were employed. The experiments consisted in inoculation with bovine tubercle bacilli and in feeding with bovine and human tuberculous material. In how far under such conditions is the relative infectivity of the bacillus of bovine and human tuberculosis demonstrable? The following summary will indicate the results that were obtained.

A.—INOCULATION EXPERIMENTS.

1. Bonnet monkey. An emulsion of the infected glands of a guinea-pig which had died after inoculation with bovine tuberculosis was injected intraperitoneally. Death occurred 19 days after the injection. Post mortem the mesenteric glands were caseating; nodules were found in the spleen, the liver, and the lungs. Tubercle bacilli were present in the lesions.

2. Rhesus monkey. The animal was injected intraperitoneally with the same material as was used for Monkey 1. Death occurred 31 days after the inoculation. Post mortem there was a general tuberculosis.

3. Rhesus monkey. Subcutaneous inoculation with bovine tuberculous material was performed. The animal died 32 days after the inoculation. Post mortem there was a general tuberculosis. Tubercle bacilli were found in the organs.

B.—FEEDING EXPERIMENTS.

(a) *With bovine tubercle bacilli*.—1. Rhesus monkey. The animal was fed with about five cubic centimetres of the emulsified udder of a cow proved to contain tubercle bacilli. It died ten days after the feeding. The result was negative owing to premature death.

2. Rhesus monkey. The animal was fed with a small portion of the emulsified udder of a cow. The result was negative as death occurred in two days.

3. Rhesus monkey. The animal was fed with a small portion of a tuberculous udder and nine days subsequently received a second feed. It died 33 days after the first feeding. Post mortem the mesenteric glands were found to be caseating and there were nodules in the spleen and the liver. Tubercle bacilli were found in all the affected organs. No intestinal lesions could be detected.

4. Rhesus monkey. The animal was fed with an emulsion of bovine tuberculous glands and 14 days subsequently with a portion of a diseased udder. It died 35 days after the first feeding. Post mortem nodules were found in the spleen, the liver, and the lungs. The mesenteric glands were enlarged. Tubercle bacilli were found in the lesions. No tuberculous lesions were observed in the intestine.

5. Rhesus monkey. The animal was fed with tuberculous udder. A second and third feed of similar material was given seven and 12 days after the first. Death occurred 45 days after the first feeding experiment. Post mortem nodules were found in the spleen, the liver, and the lungs and the mesenteric glands were enlarged. There were no lesions in the intestine. Tubercle bacilli were found in the affected organs.

6. Rhesus monkey. The animal was fed with a small portion of affected cow's lung and on the ninth and thirty-fifth days a second and third feed were given of similar material. Death followed 57 days after the first feeding. Post mortem general tuberculosis was found but there were no lesions in the intestine.

7. Rhesus monkey. The animal was fed with emulsified lesions of bovine lung. Only one feeding experiment was made. Death took place 65 days subsequently. Post

mortem there was general tuberculosis but there were no intestinal lesions. Tubercle bacilli were found in the affected tissues.

(b) *With human tubercle bacilli*.—1. Rhesus monkey. The animal was fed with tuberculous sputum. Diarrhoea ensued and death took place after ten days. There were no visible post-mortem signs.

2. Rhesus monkey. Tuberculous sputum was given per os. Diarrhoea supervened and death occurred in ten days. There were no post-mortem signs.

3. Rhesus monkey. Tuberculous sputum was given and the animal died in two days. No post-mortem signs were present.

4 and 5. Rhesus monkeys. The animals were fed with non-tuberculous sputum from a healthy individual in order to control the results in Monkeys 1, 2, and 3. No injurious effects occurred and both animals were alive and well three months after feeding with normal sputum.

6. Rhesus monkey. The animal was fed with normal sputum without ill-effect. Subsequently tuberculous sputum was given and it died within 30 days. Post mortem there was general tuberculosis and bacilli were found in the lesions. Guinea-pigs inoculated with emulsions of the glands and the spleen died from tuberculosis. Tuberculous ulcers were present in the intestine of the monkey.

7. Rhesus monkey. The animal was fed twice with tuberculous sputum and died at the end of 43 days. Post mortem nodules were found in the liver and the spleen. The mesenteric glands were enlarged and distinct intestinal lesions were present. Guinea-pigs after inoculation with the diseased tissues died from tuberculosis in from four to six weeks.

8. Rhesus monkey. The animal was fed once with tuberculous sputum and died 65 days later. Post mortem there were general tuberculosis and ulceration of the intestine. Tubercle bacilli were present in the various lesions.

In the above experiments the monkey proved susceptible to an inoculation with the bacillus of bovine tuberculosis either directly or after one passage through the organism of

the guinea-pig. A certain number of the animals died in two or in ten days after feeding with bovine and human tuberculous material. Normal human sputum did not produce this effect and the result suggested some form of intoxication. The monkey fed thrice, twice, or once with the bovine material succumbed to a general tuberculosis in about from one to two months, and fed with the human material the same results and fatal effect were produced in about the same period of time. The young monkey proved to be equally susceptible to the bovine and human strains of the tubercle bacilli. The striking difference in the effects produced occurred in the digestive tract. Intestinal lesions were found in the case of every monkey that had been fed with human tuberculous material, whilst none of the monkeys fed with the bovine material presented any evidence of tuberculous ulcers in the intestine. Within the limits of these experiments it would appear that virulent bovine tubercle bacilli may pass through the intestinal wall in large numbers without any detectable lesion of the gut being produced. It would also appear that a food tuberculosis can be as readily brought about by the bovine as by the human strain of the tubercle bacillus in the young monkey.

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